**Genetics Problems: Gene Linkage**

**Multiple Choice Question 1**

Gene loci M, X, H and J are in the same linkage group, but not necessarily in that order.

A number of test crosses were carried out, each cross involving two of the gene loci. For each pair of gene loci considered a percentage recombination value was obtained. These values were:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Loci Pair | M and X | M and J | X and H | J and H |
| % Recombination | 16 | 10 | 11 | 5 |

What is the order of the loci?

1. M, H, J, X
2. X, H, J, M
3. M, J, X, H
4. X, M, J, H

**Short Answer Question 1**

In maize, two genes located on chromosome 4 are:

Gene 1: leaf texture G = glossy leaves, g = rough leaves

Gene 2: leaf colour J = green leaves, j = green with white stripes

The two genes are 26 map units apart.

A plant, pure-breeding for each of the recessive traits (parent plant 1) was crossed with a plant pure breeding for each of the dominant traits (parent plant 2). Offspring were produced.

1. Draw the number 4 chromosome of each parent plant and label the appropriate alleles present in each
2. Draw the number 4 chromosome in the offspring and label the appropriate alleles present
3. What kinds of gametes with respect to these two genes will the hybrid offspring produce and in what proportions?

**Short Answer Question 2**

Two genes located on chromosome 4 in maize are:

Gene 1: pollen size S = normal pollen size, s = small pollen

Gene 2: endosperm type D = normal endosperm, d = defective endosperm

The following cross was carried out:



Six percent of the offspring were determined to have the genotype:



1. Were these offspring parental or recombinant type?
2. What is the map distance between the two gene loci concerned?
3. What is the genetic make-up of the remainder of the offspring and what would be the expected proportion of each?

**Short Answer Question 3**

Consider the following hybrid where the genes are 22 map units apart.



What kind of gametes are possible and what proportion of each would you expect?

**Short Answer Question 4**

Drosophila has three linked genes: scute bristles (sc), forked bristles (f) and garnet eyes (g). The wildtype allele for each gene is denoted by a +. A female, heterozygous at each gene locus, was test-crossed to produce the following offspring:

sc+ f+ g+ 9

sc f g+ 141

sc+ f g+ 63

sc f g 5

sc+ f+ g 172

sc f+ g 37

sc f+ g+ 29

sc+ f g 34

**Total 490**

1. What is the order of the three gene on the chromosome?
2. What is the map distance between each of the gene loci?

**Answers**

**Multiple Choice Question 1**

A

% recombination = how far away loci are on the gene map

M 🡪 5 🡪 H 🡪 5 🡪 J 🡪 6 🡪 X

**Short Answer Question 1**

a.

 

b.



c.



**Short Answer Question 2**

a. Recombinant type

b. 12 map units

c.



**Short Answer Question 3**



**Short Answer Question 4**

a. sc-g-g

b. Distance between loci sc-g = (9 + 5 + 63 + 37)/490 = 23 map units

Distance between loci g-f = (9 + 5 + 29 + 34)/490 = 15 map units

Distance between sc and f must be 23 + 15 = 38 map units